Boreal ALFRESCO: Landscape Simulation Software

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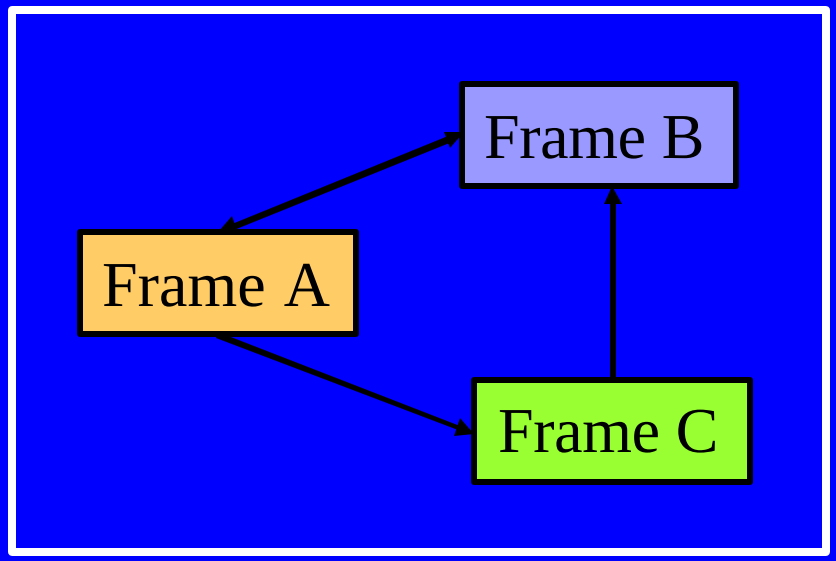
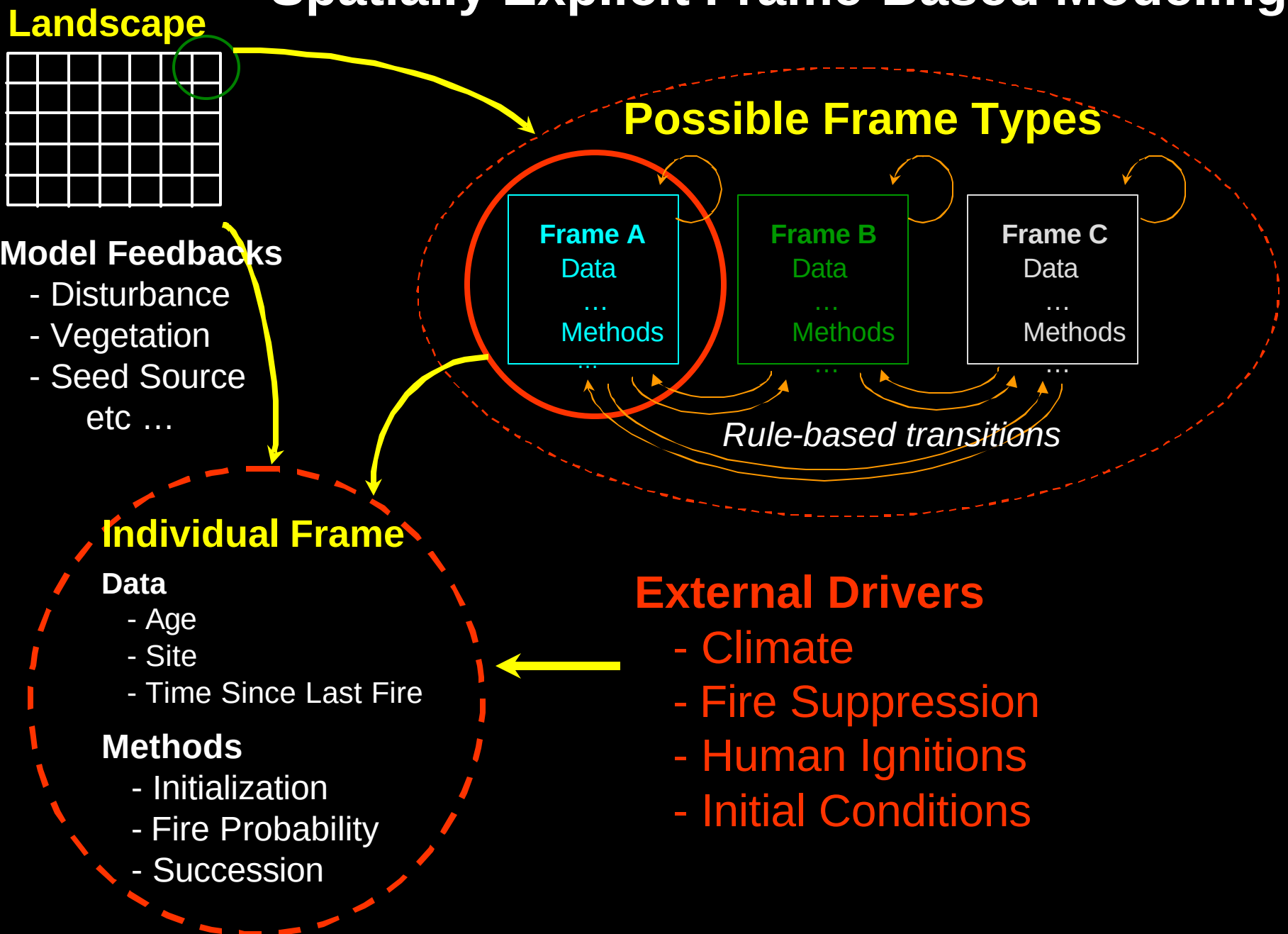
Frame-based Paradigm

- Top down approach
- State-transition model
- Independent modules
- Focuses on interactions and feedbacks
- Utilizes quantitative and/or qualitative data



Spatially Explicit Frame-Based Modeling



ALFRESCO .FIF Climate Options

Type:

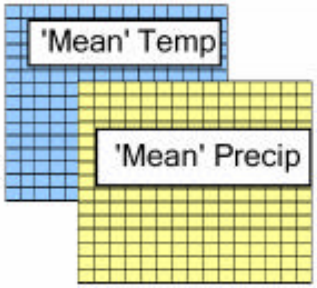
1) CONSTANT

Single Temp and Precip value used for every cell in all years and replicates

2) SPATIAL

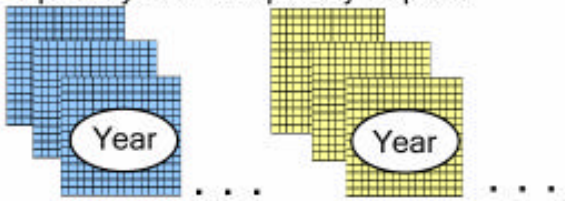
Spatially Explicit Temp and Precip values

Temporally Constant



3) EXPLICIT

Spatially and Temporally Explicit

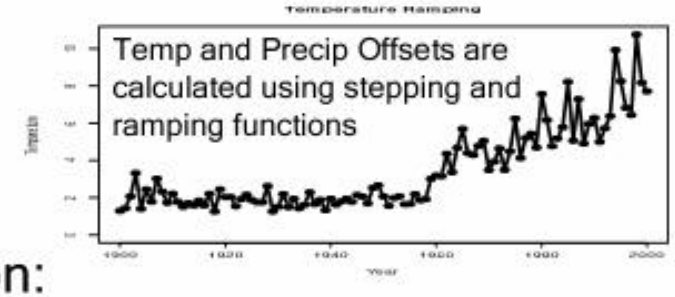


Offset Type (Anomalies):

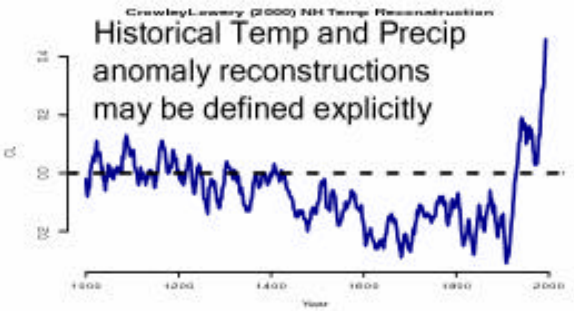
1) NONE

(Generally used for Type = EXPLICIT)

2) RAMPED



3) FILE



Offset Application:

1) DIRECT

Offsets applied directly to climate values

2) STOCHASTIC

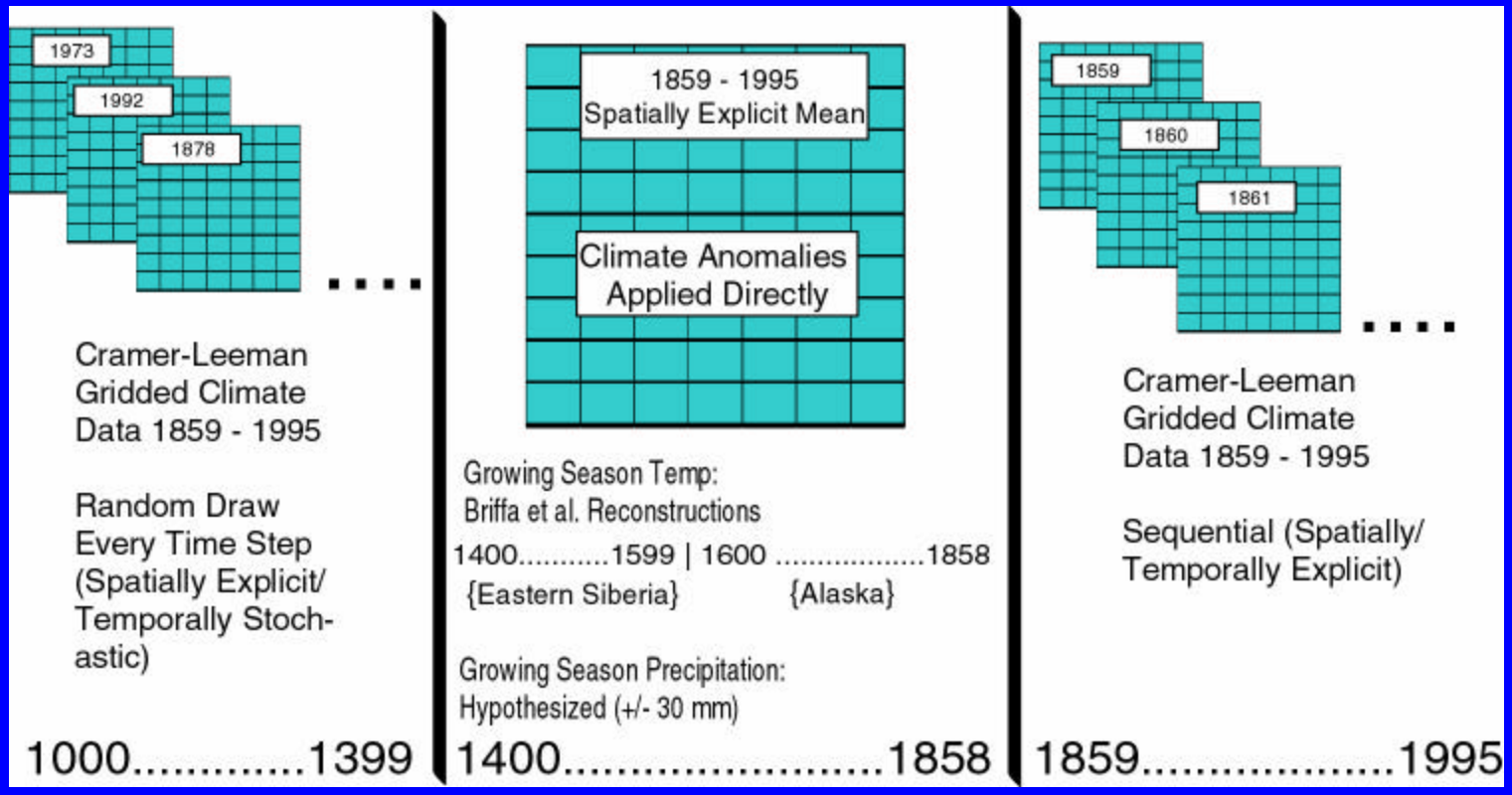
Offsets randomly generated from a user defined Normal Distribution.

-- Offsets are regenerated for each Rep

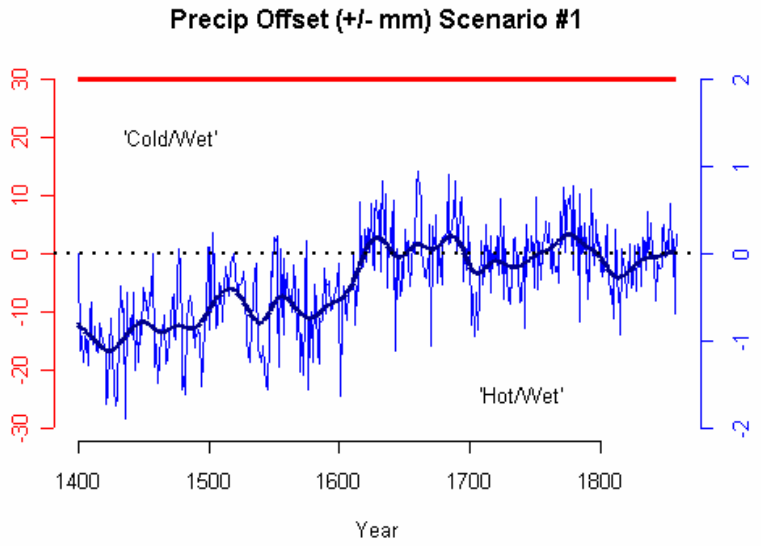
3) REPLICATED

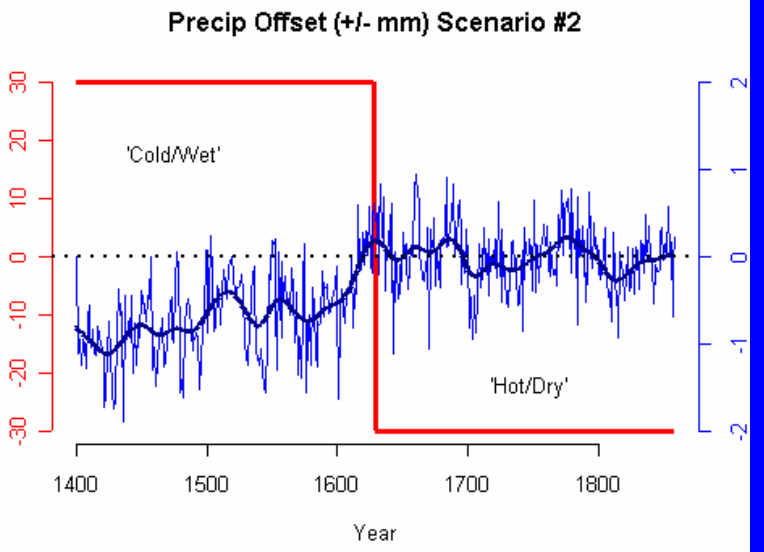
-- Offsets constant across Reps

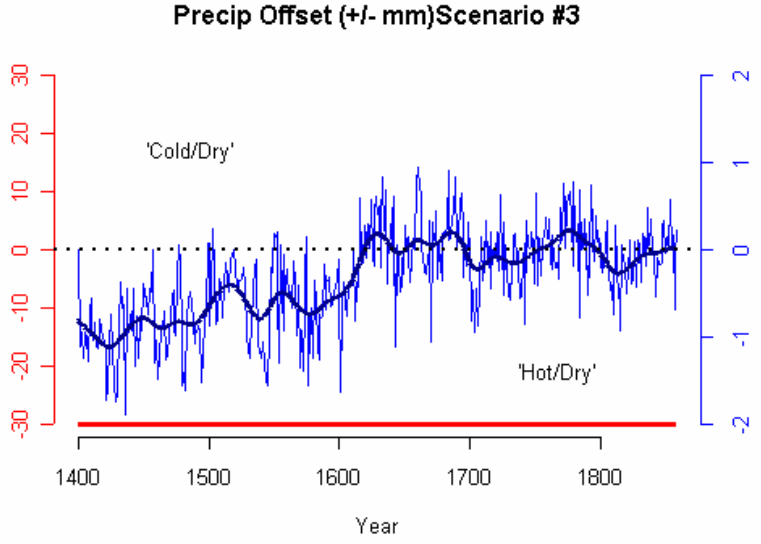
ALFRESCO Little Ice Age Climate Scenarios

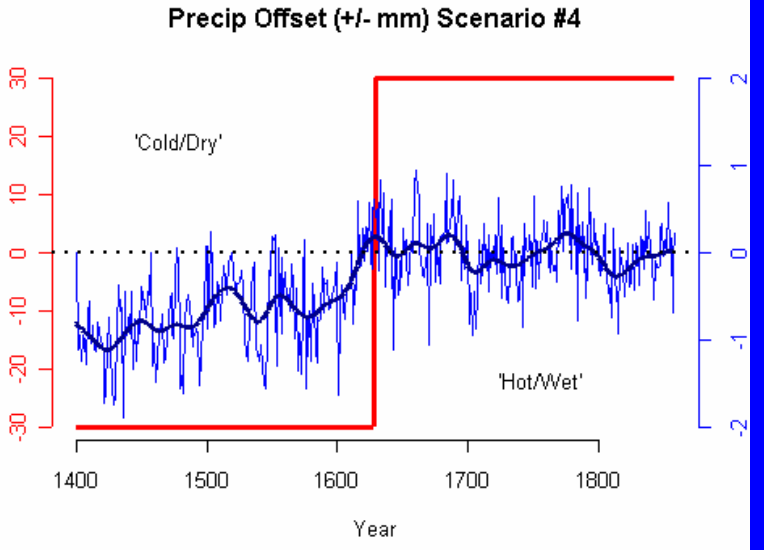


Hypothesized Precipitation Scenarios





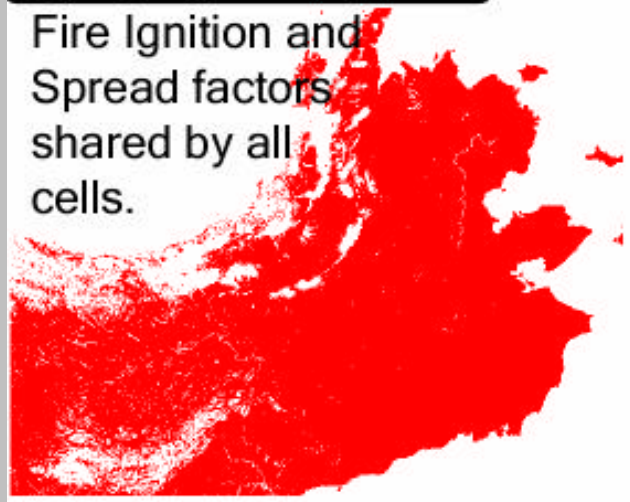




ALFRESCO .FIF Fire Options

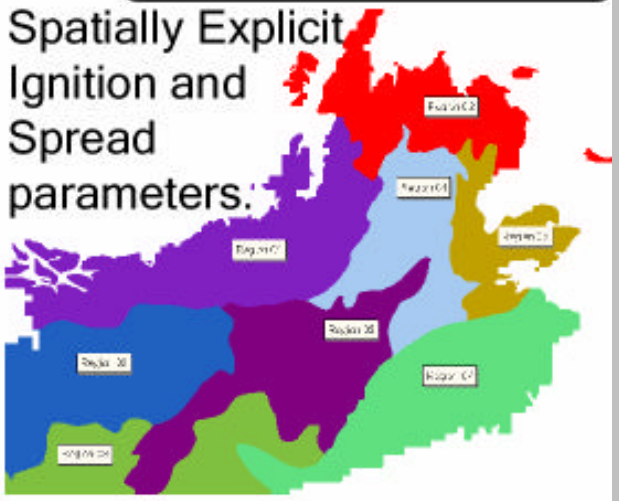
FIXED

Fire Ignition and Spread factors shared by all cells.



SPATIAL

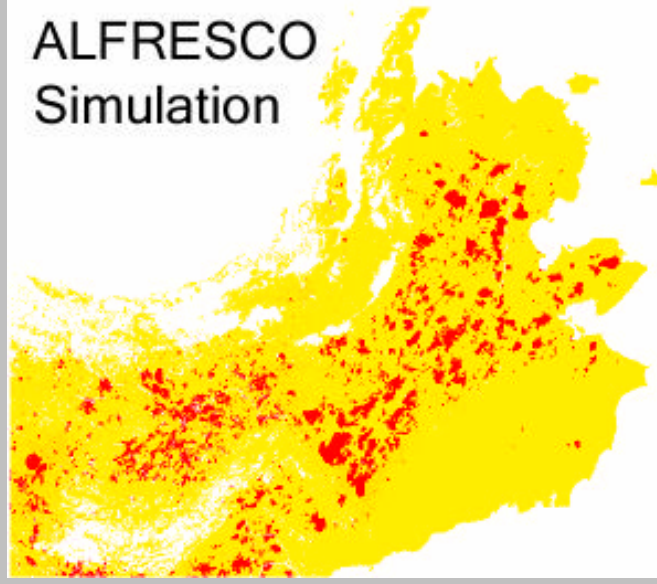
Spatially Explicit Ignition and Spread parameters.



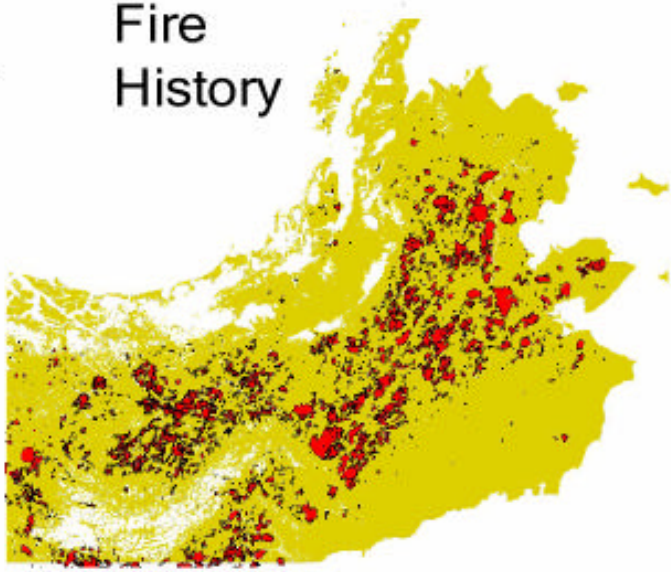
HISTORICAL

User Defined Fire placement. This can be in the form of historical burn scars, or hypothesized prescribed burns.

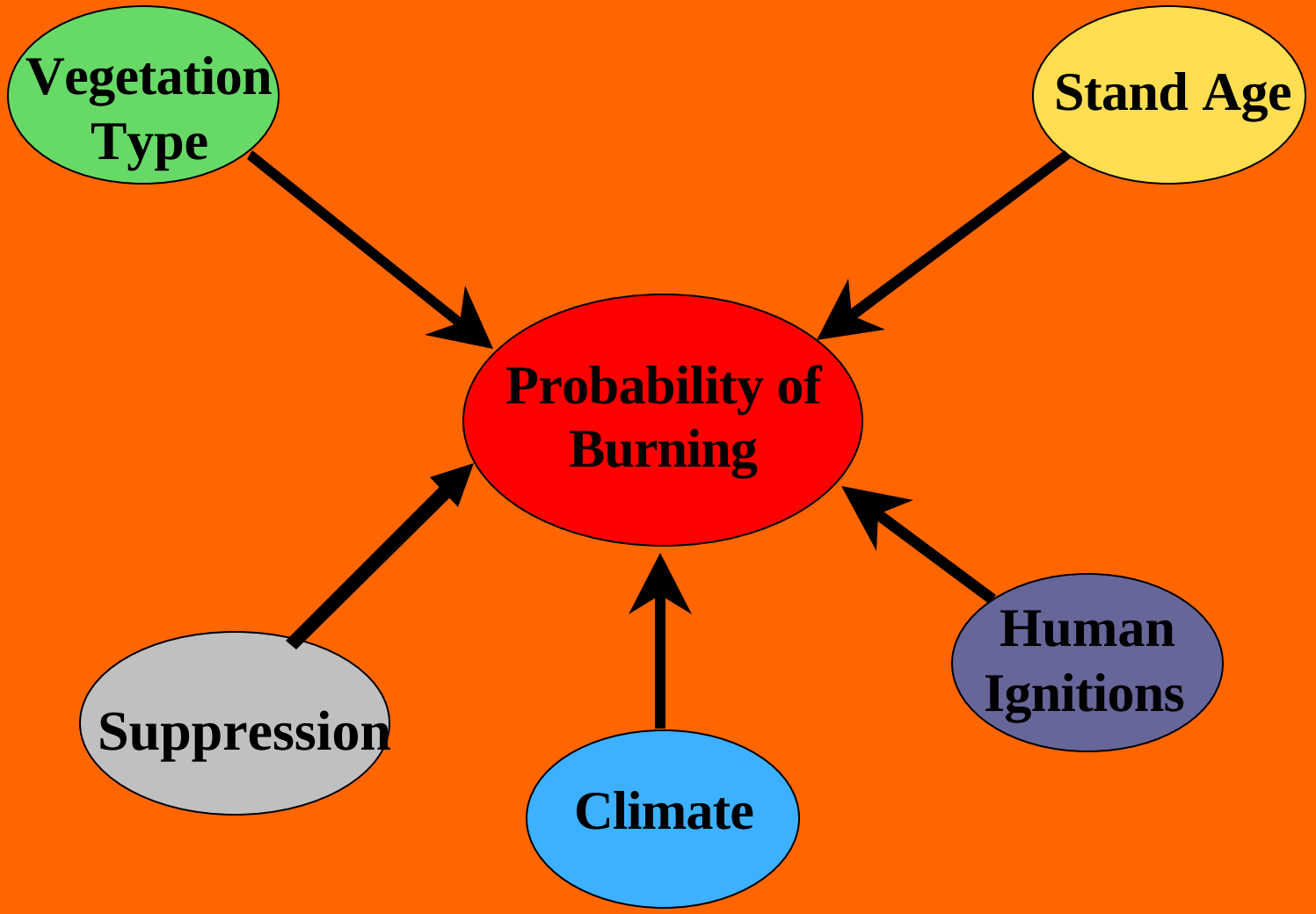
ALFRESCO Simulation



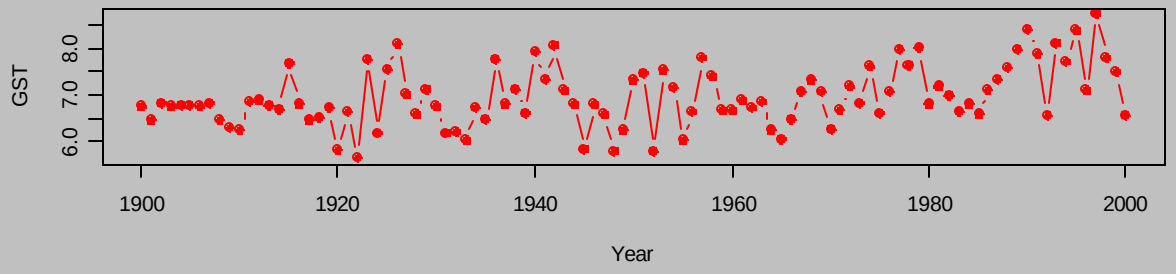
Fire History

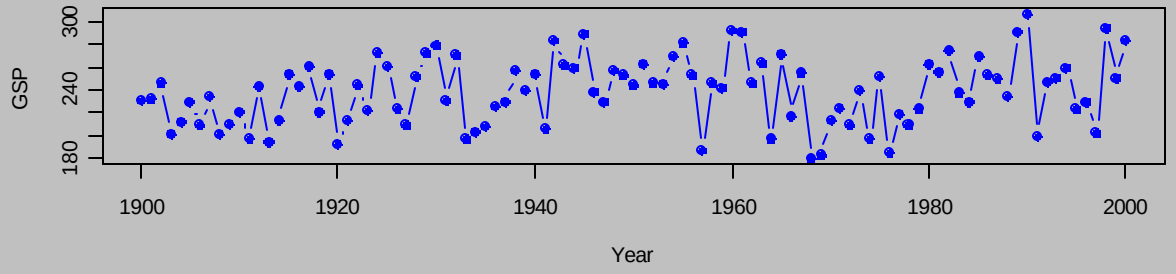


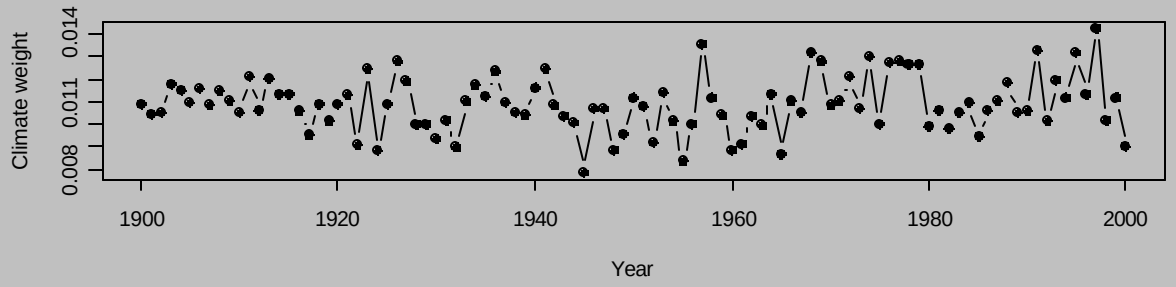
Individual Cell Flammability



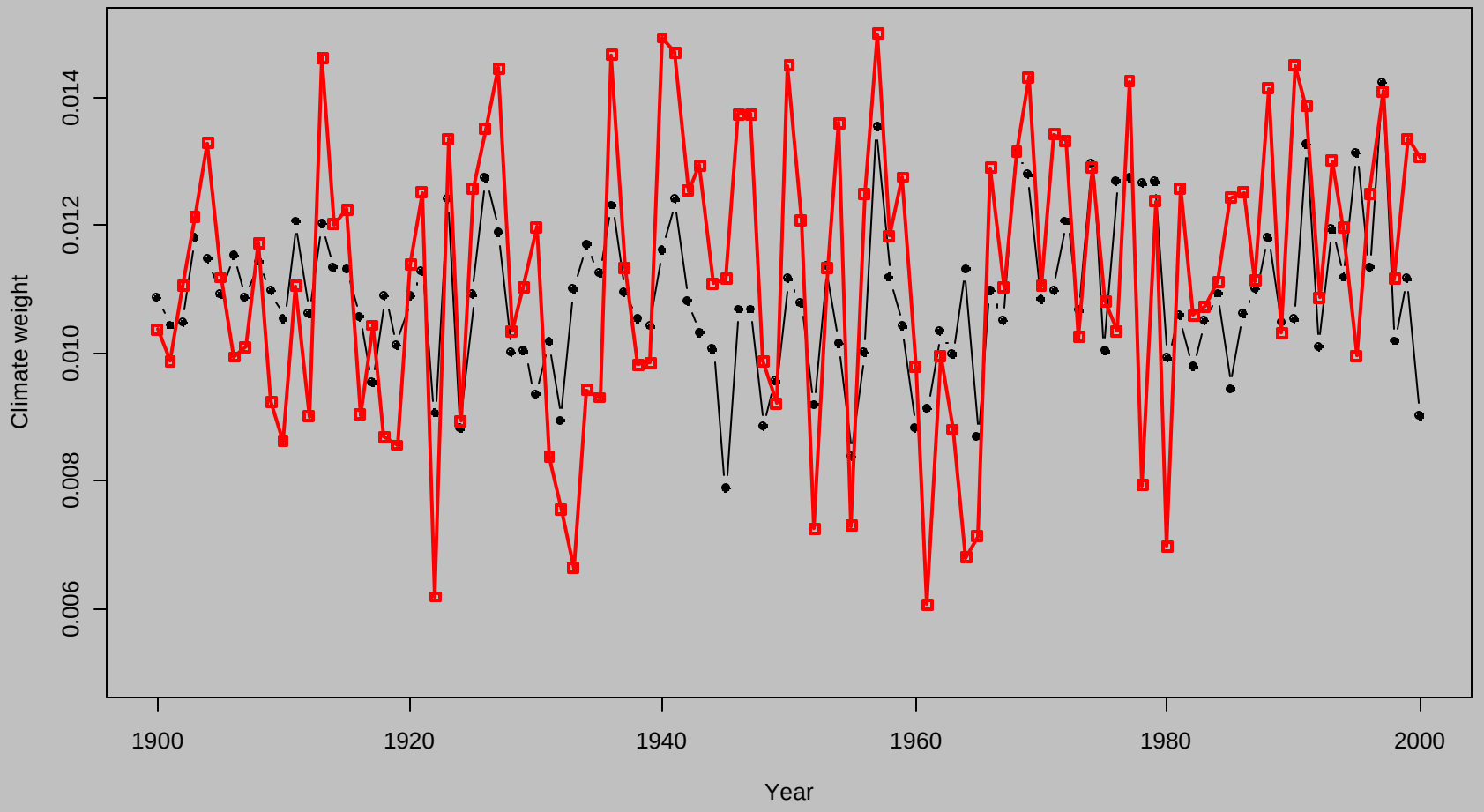
Fire-Climate Interaction



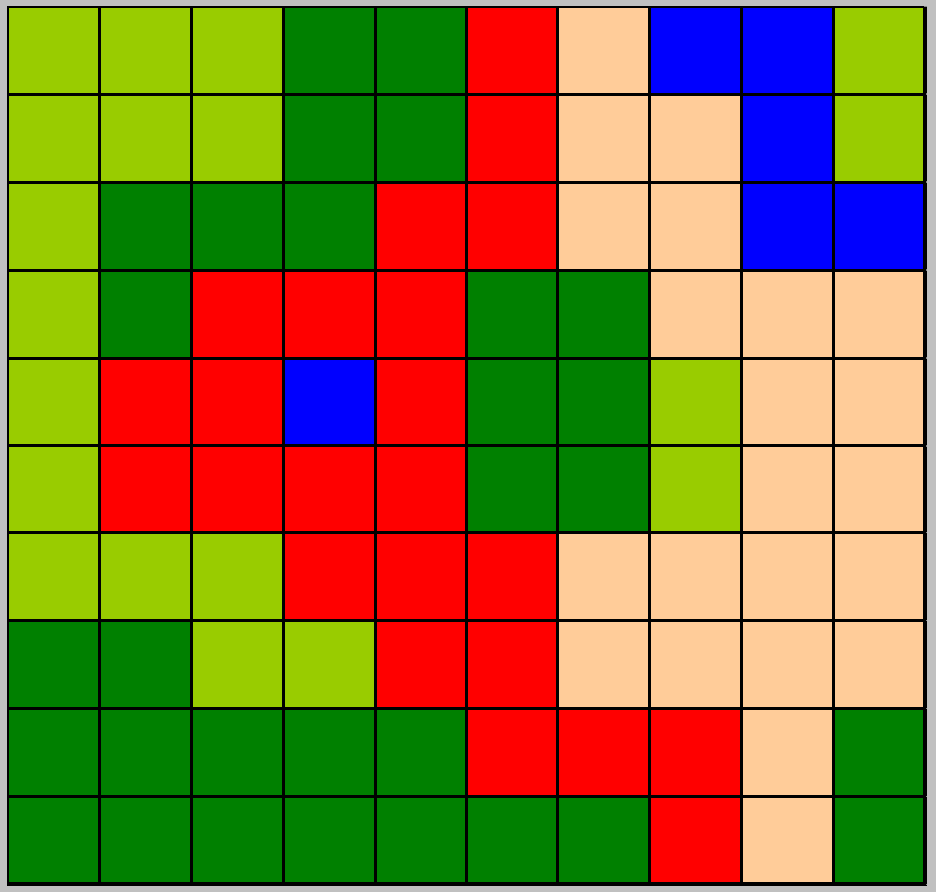


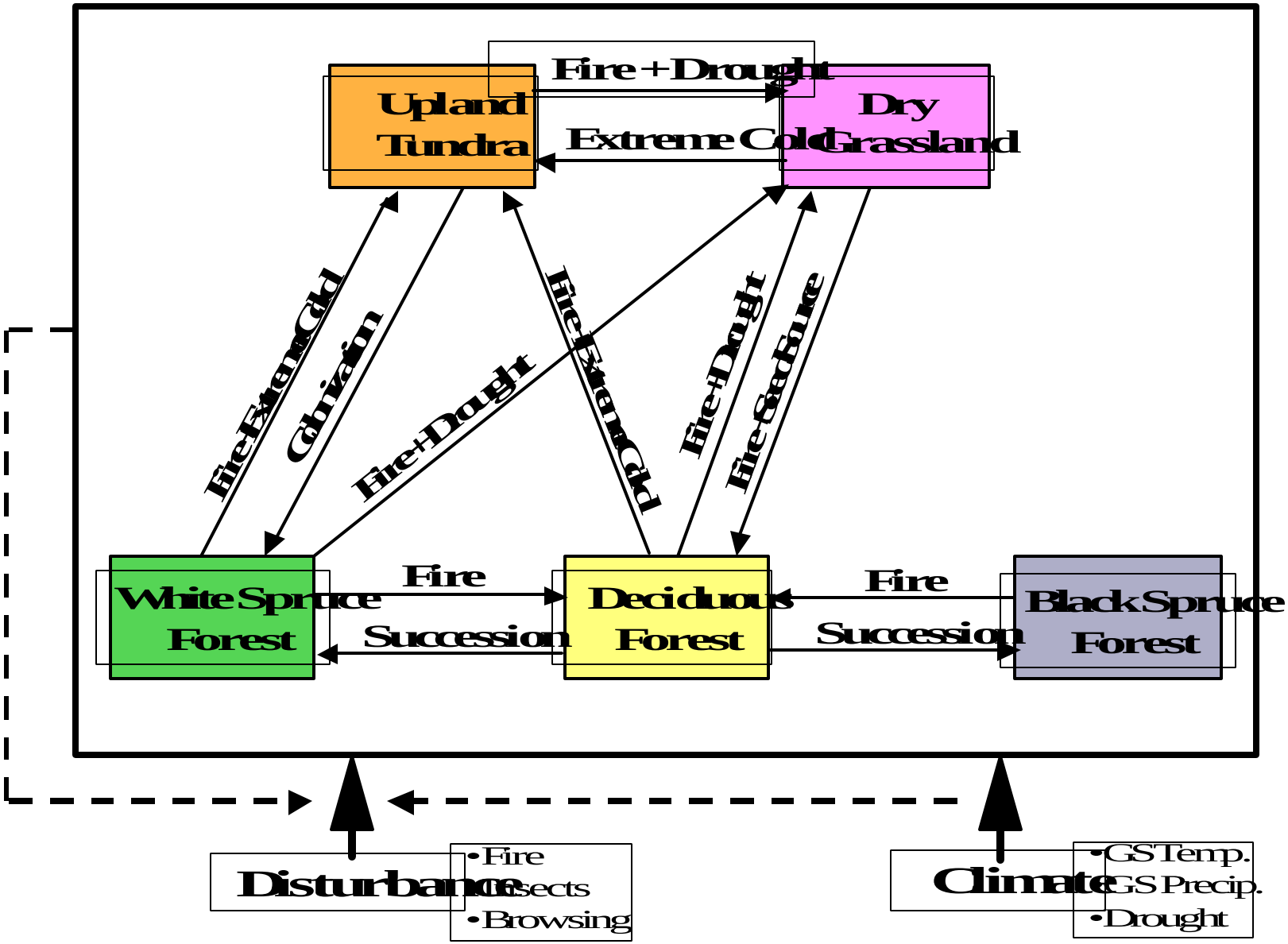


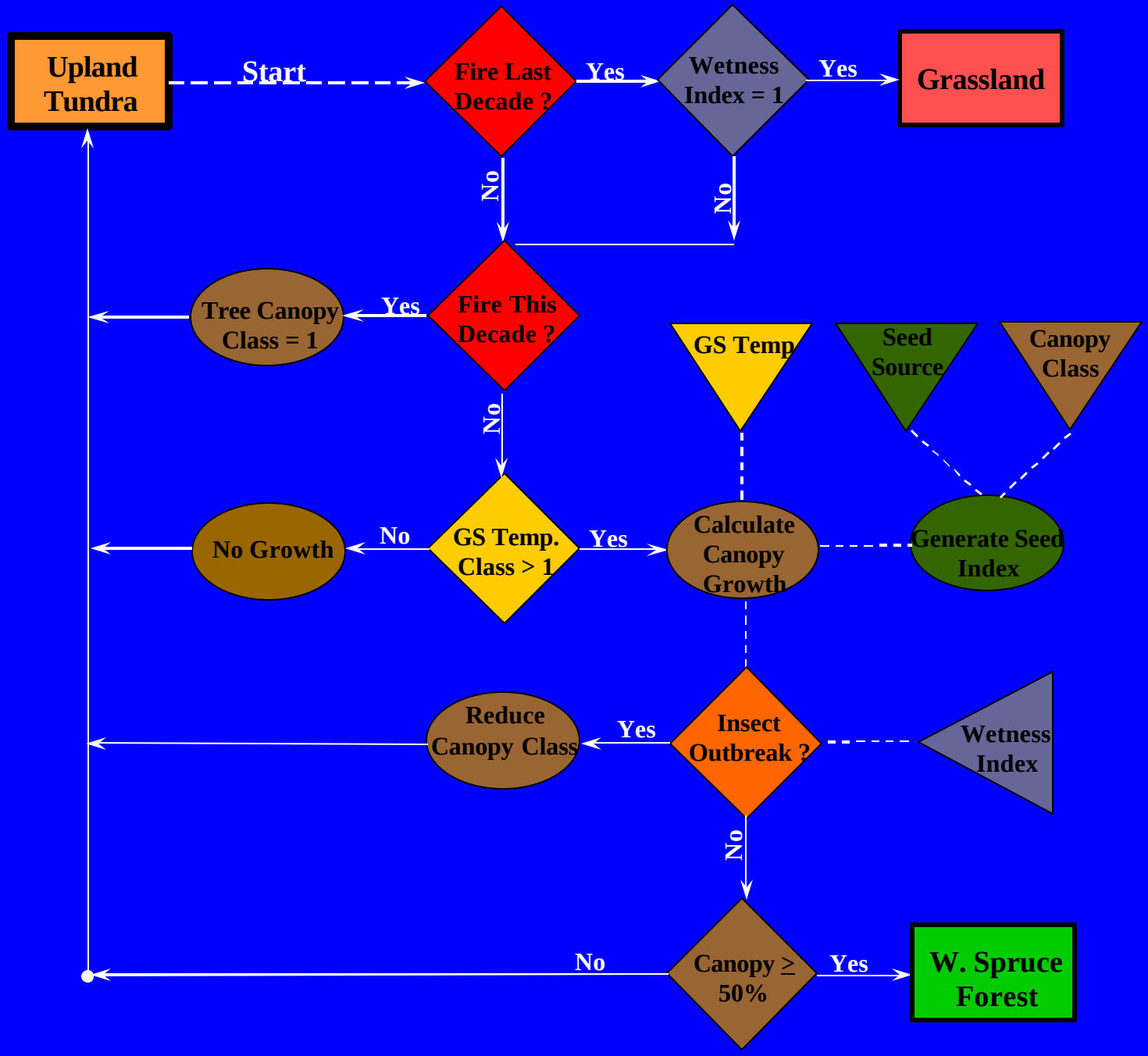
Fire-Climate Interaction



Recursive Fire Spread Algorithm




Upland Tundra
Fire + Drought
Extreme Cold
Dry Grassland
Fire+Extreme Cold
Colonization
Fire+Drought
Fire+Extreme Cold
Fire+Drought
Fire+Colonization
White Spruce Forest
Fire
Succession
Deciduous Forest
Fire
Succession
Black Spruce Forest
Disturbance
•Fire
•Insects
•Browsing
Climate
•GS Temp.
•GS Precip.
•Drought


Upland Tundra
Start
Fire Last Decade ?
Yes
Wetness Index = 1
Yes
Grassland
No
No
Tree Canopy Class = 1
Yes
Fire This Decade ?
GS Temp
Seed Source
Canopy Class
No
No Growth
No
GS Temp. Class > 1
Yes
Calculate Canopy Growth
Generate Seed Index
Reduce Canopy Class
Yes
Insect Outbreak ?
Wetness Index
No
No
Canopy ≥ 50%
Yes
W. Spruce Forest

Model Input Data Layers

Required:

- Vegetation
- Aspect
- Canopy Cover
- Base Climate

Optional:

- Fire Perimeters
- Climate Scenarios
  - Spatially explicit
  - Spatio-temporal explicit
  - Offset vectors
- Stand Age
- Fire Parameters
  - Ignition factors
  - Spread factors
  - Suppression effects

Model Output Options

Time Series:

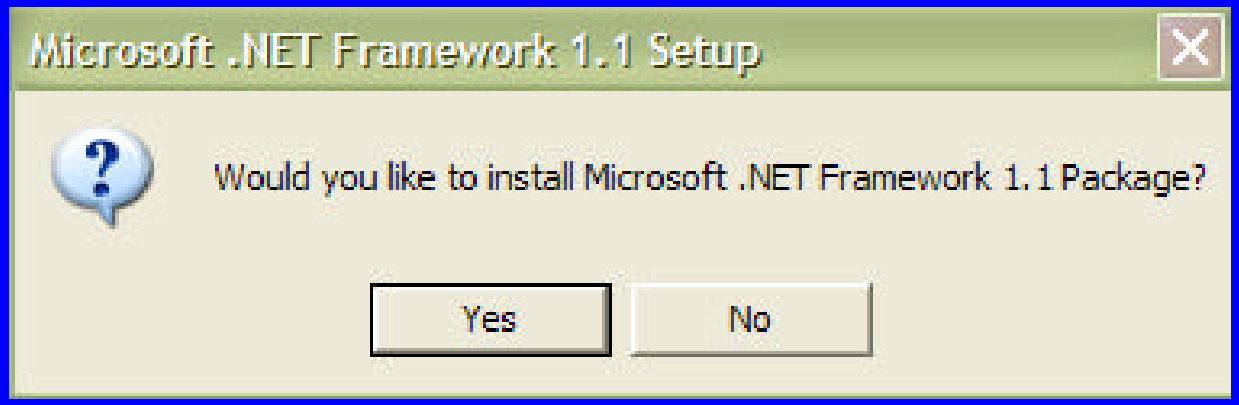
- Summary
- Data
- Event
  - Vegetation
    - Distribution/Composition
    - Residence times
    - Histograms
  - Fire
    - Number of fires
    - Area burned
    - Mean fire size
    - Fire intervals
    - Species specific
    - Histograms

Map Layers:

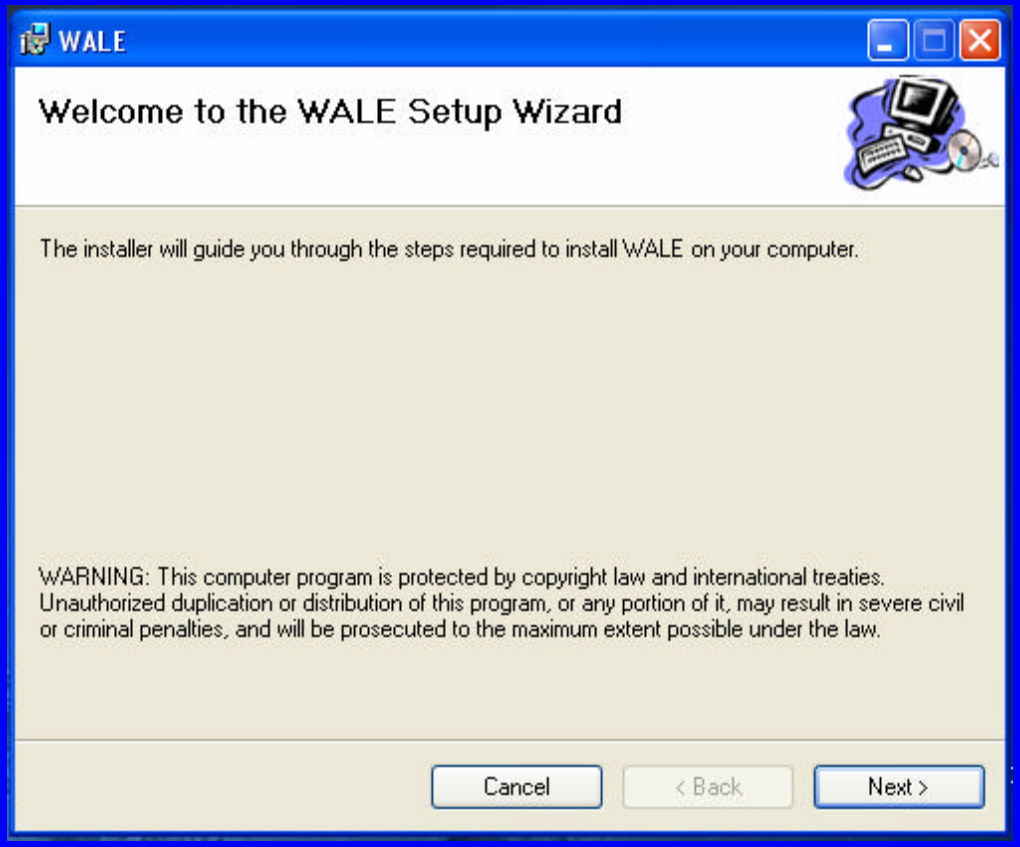
- By Year
- By Replicate
  - Vegetation
  - Age
  - Site
  - Residence Times
  - Area Burned
  - TSLF
  - Climate
    - Temperature
    - Precipitation
  - Etc.

Model Installation

Install Microsoft .NET Framework 1.1

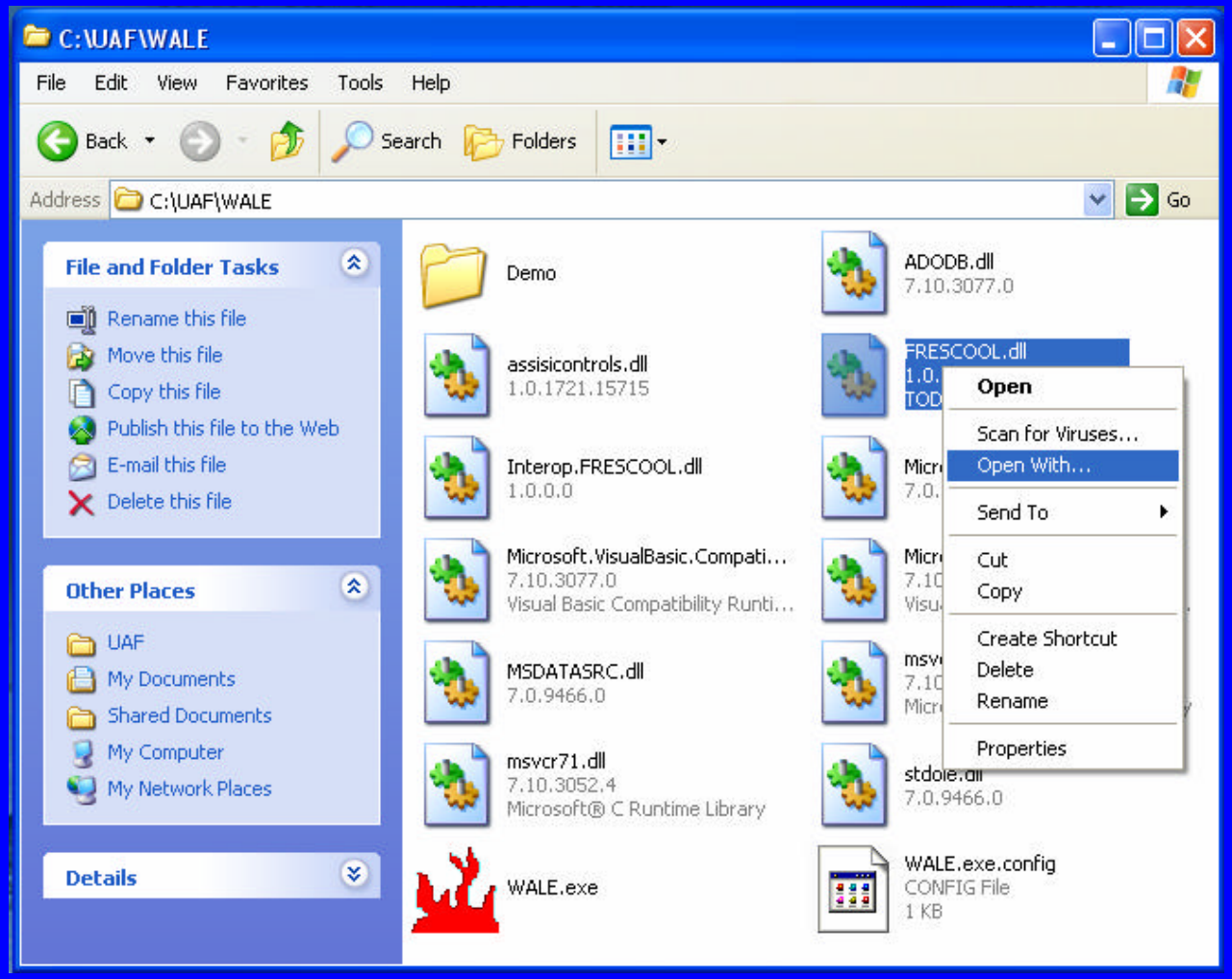


Install WALE 2 Software

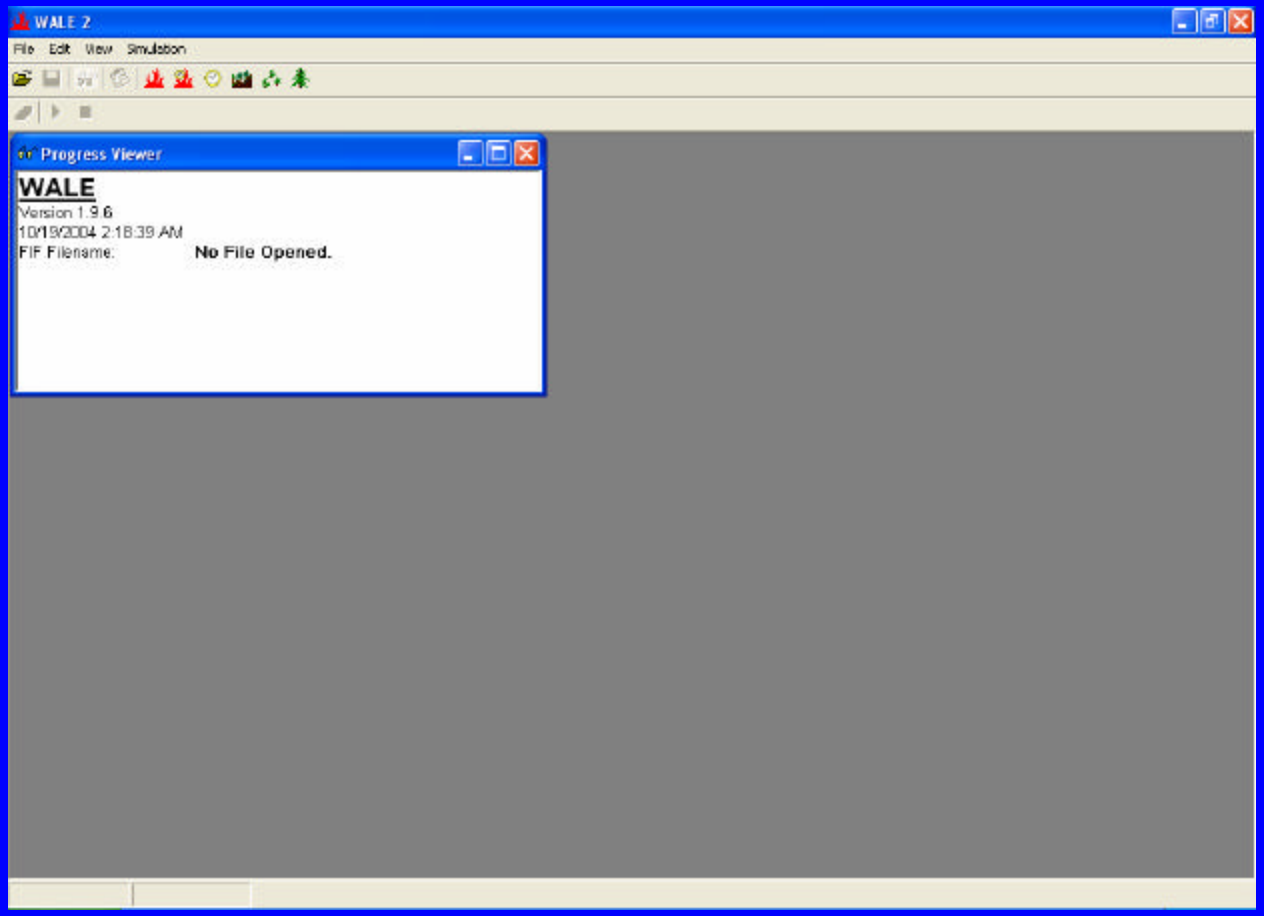


WALE 2 Icon

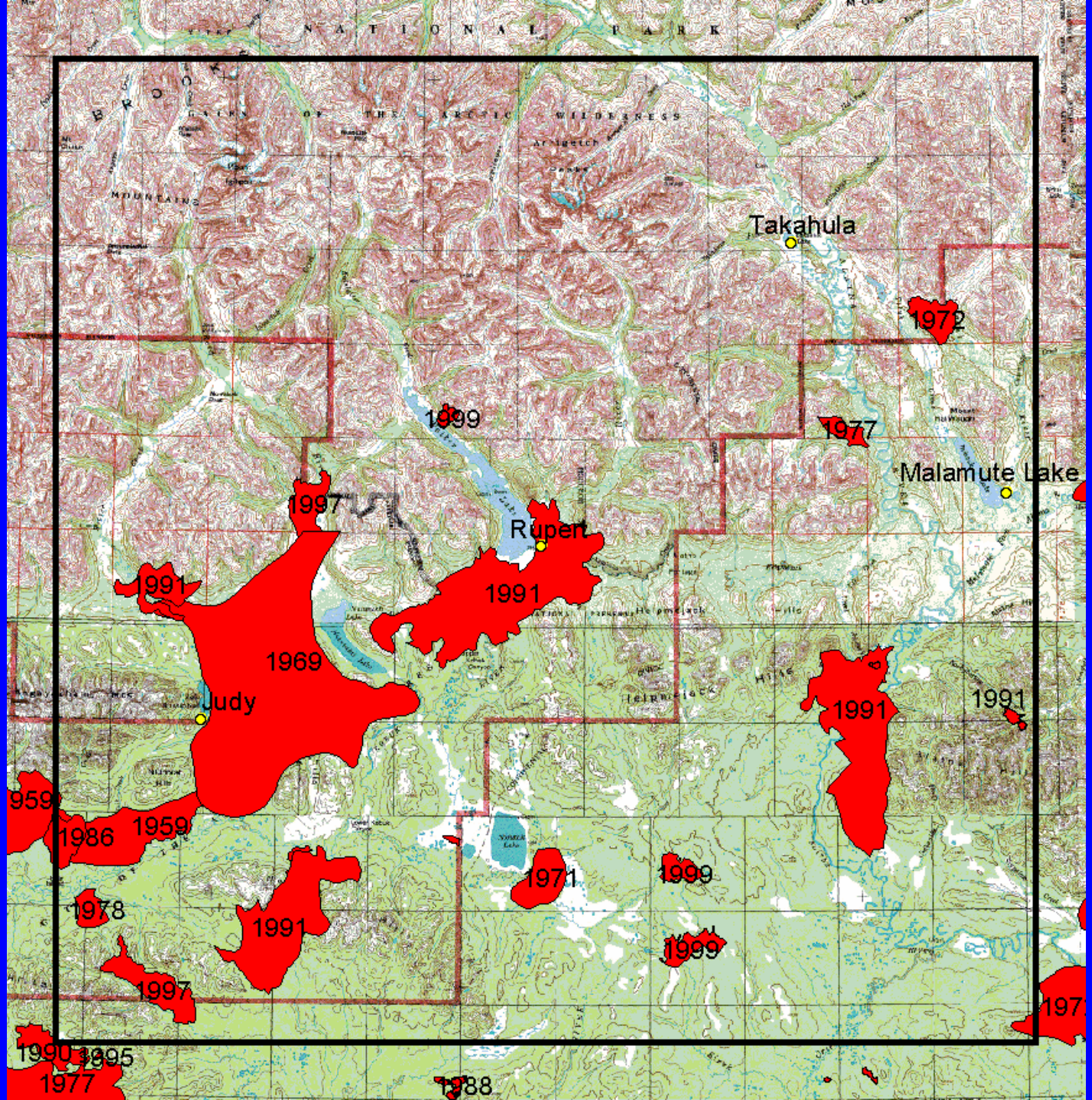
Activating the FRESCOOL.dll

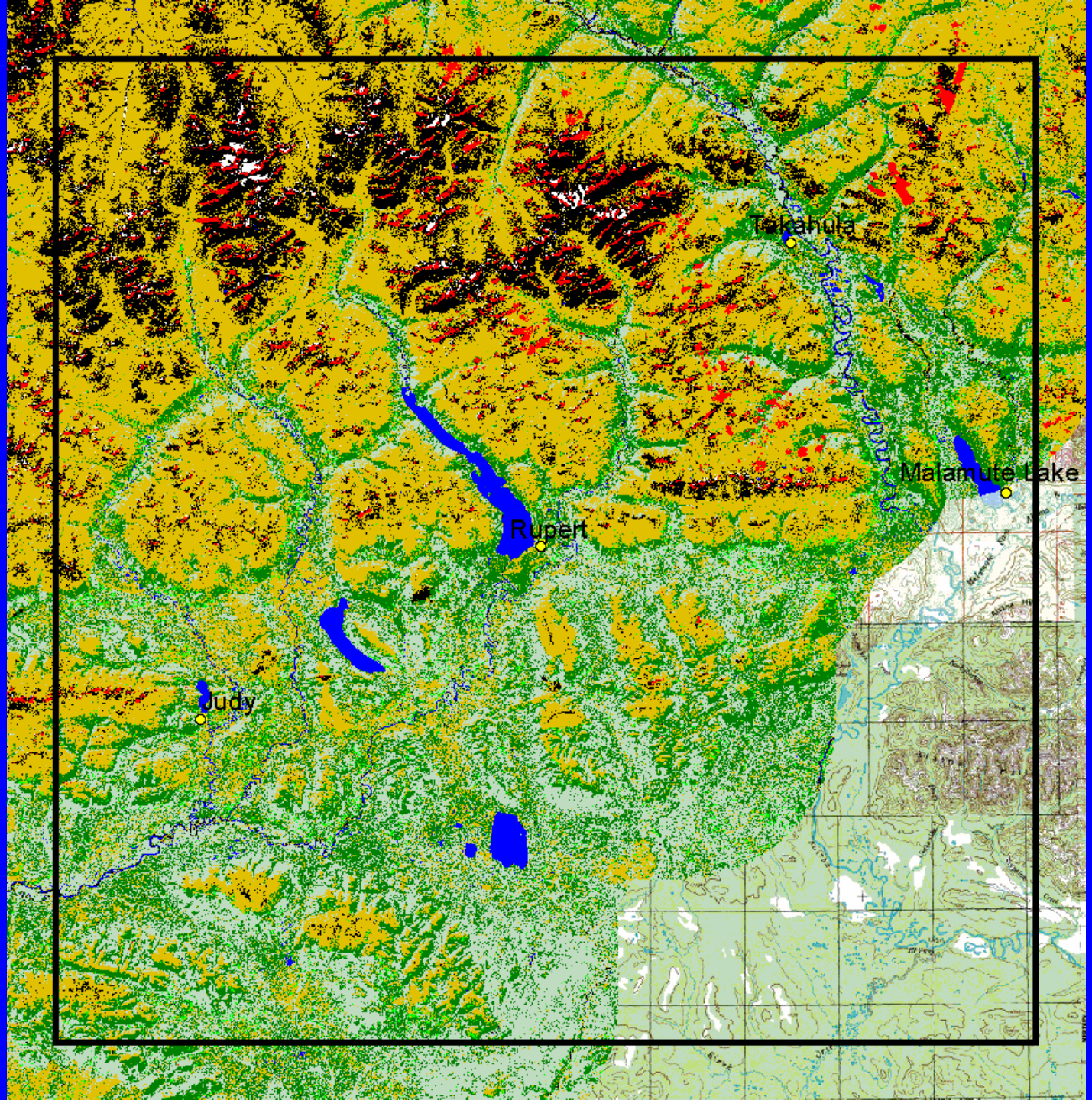


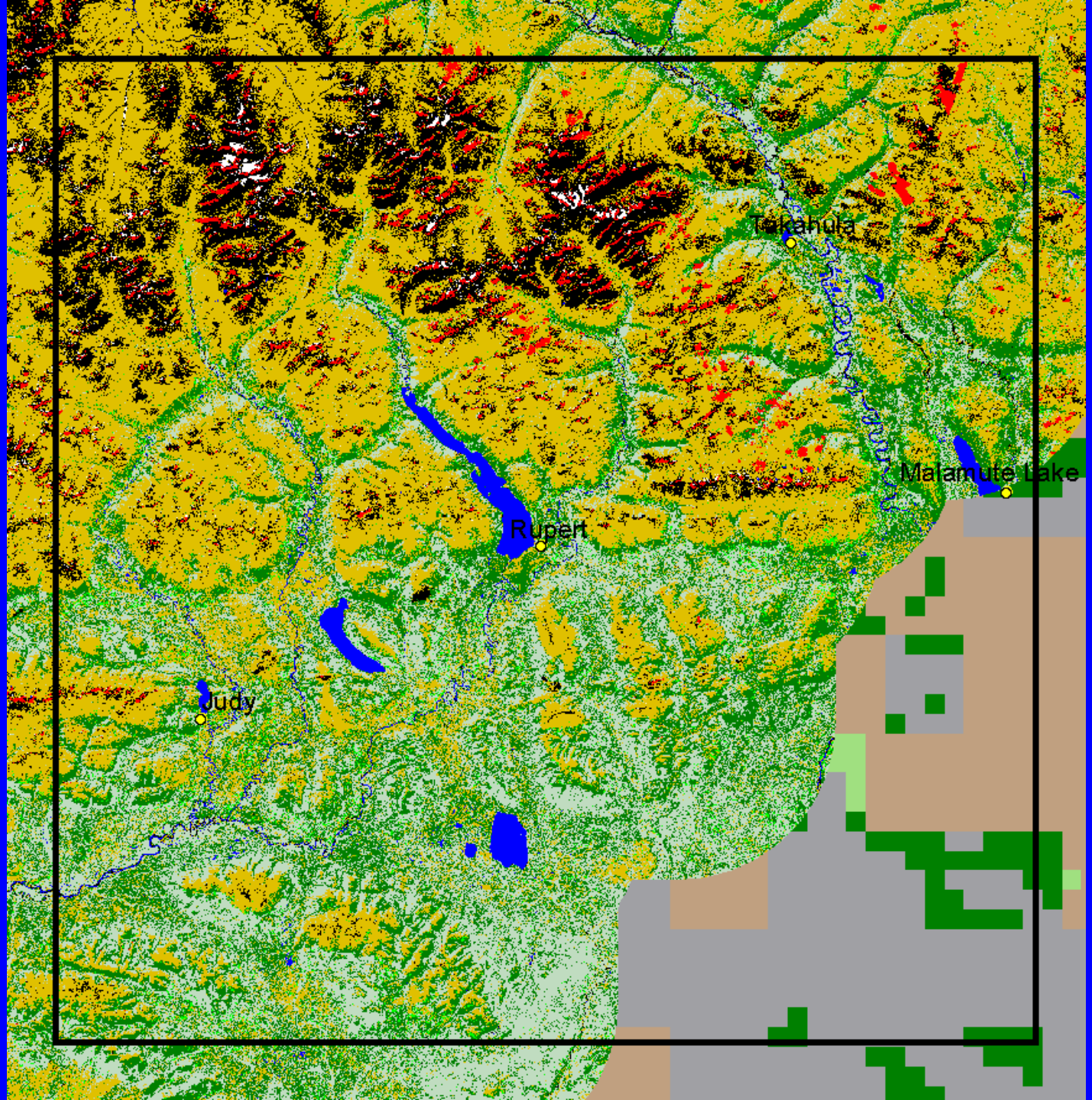
WALE 2 Program Window

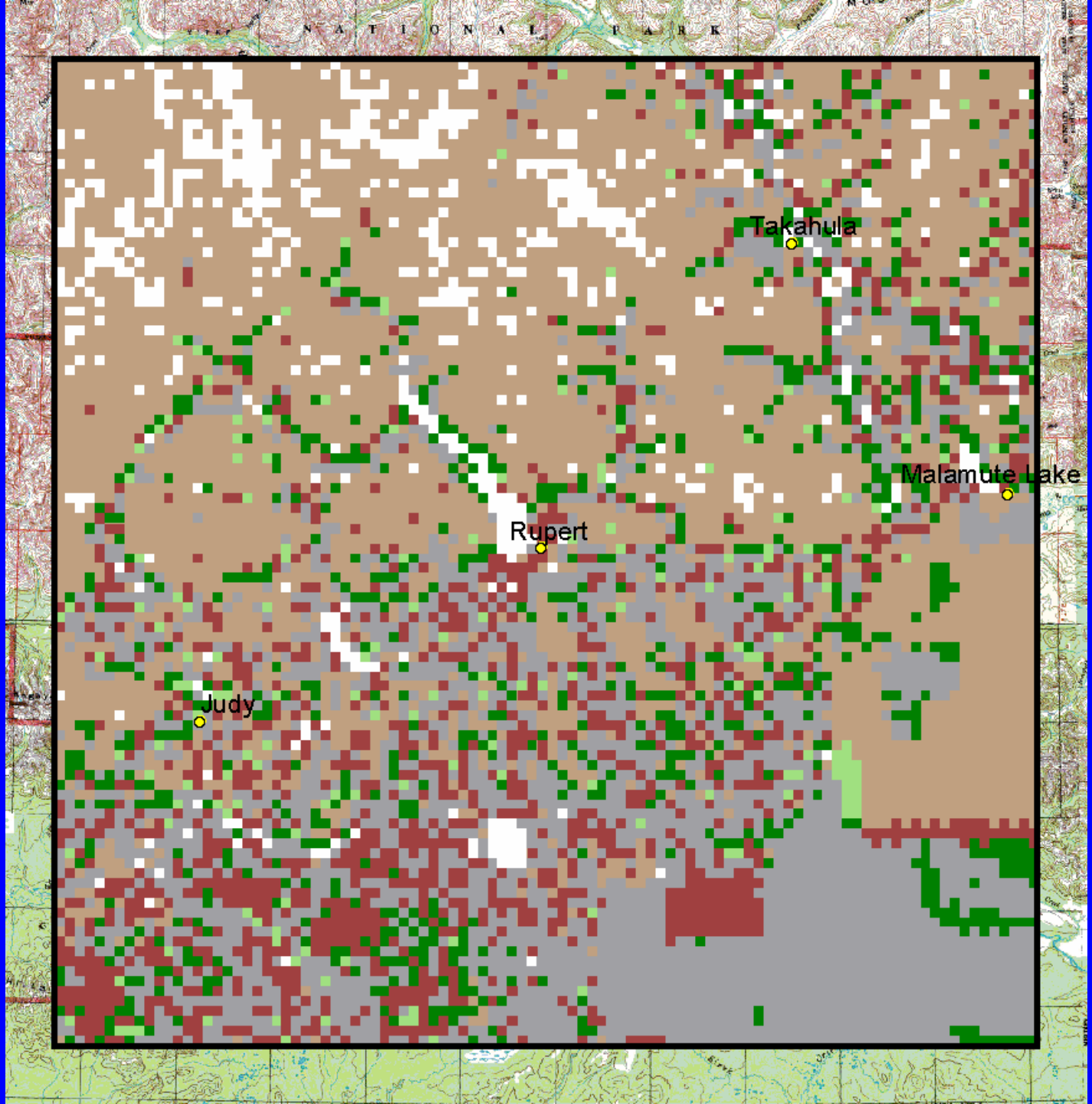


WALE 2 Tutorial and Demo

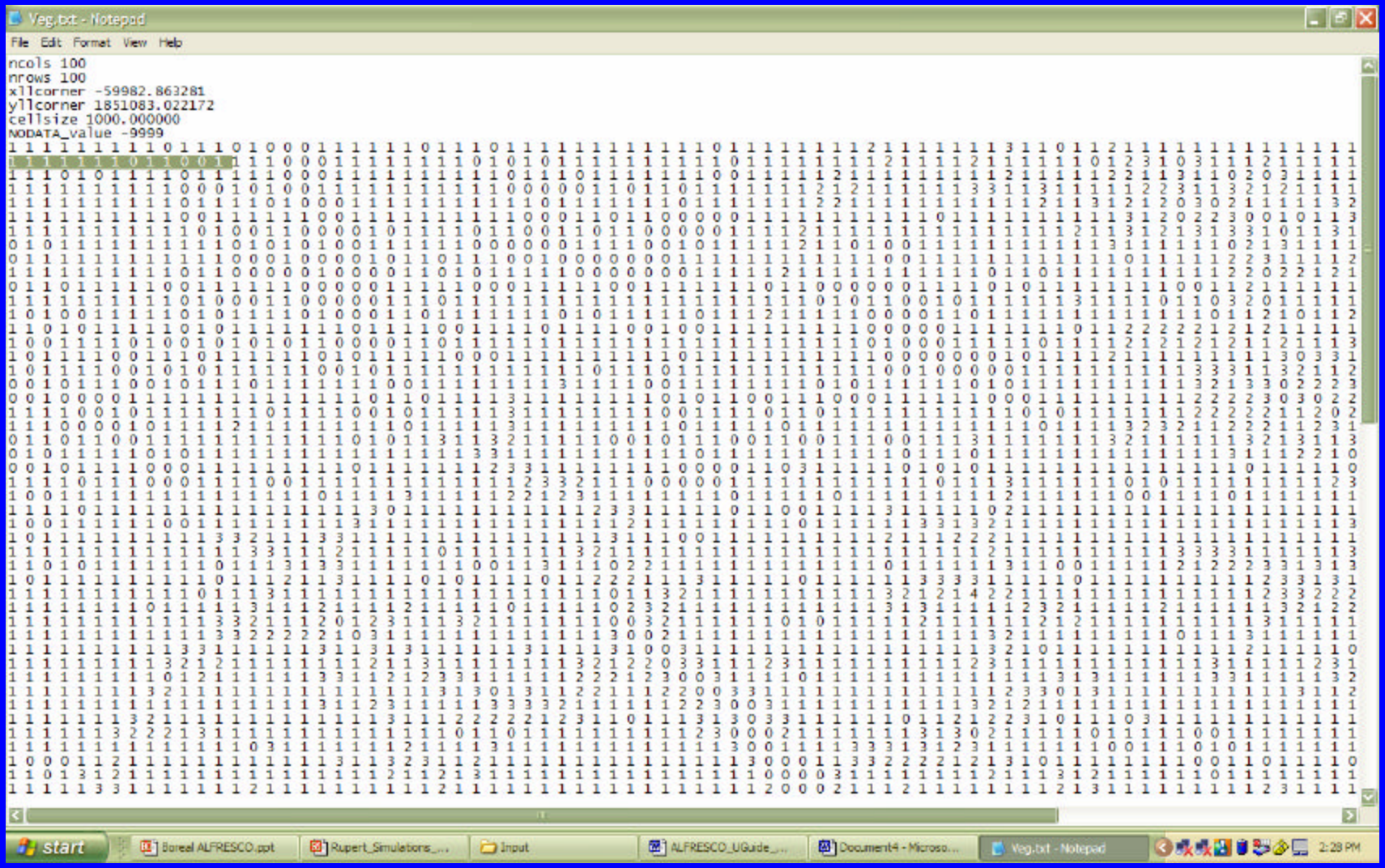

Takahula
Malamute Lake
Rupert
Judy
1972
1999
1977
1997
1991
1991
1969
1991
1991
1959
1986
1959
1971
1999
1978
1991
1999
1997
1990
1995
1977
1988


Takahula
Malamute Lake
Rupert
Judy

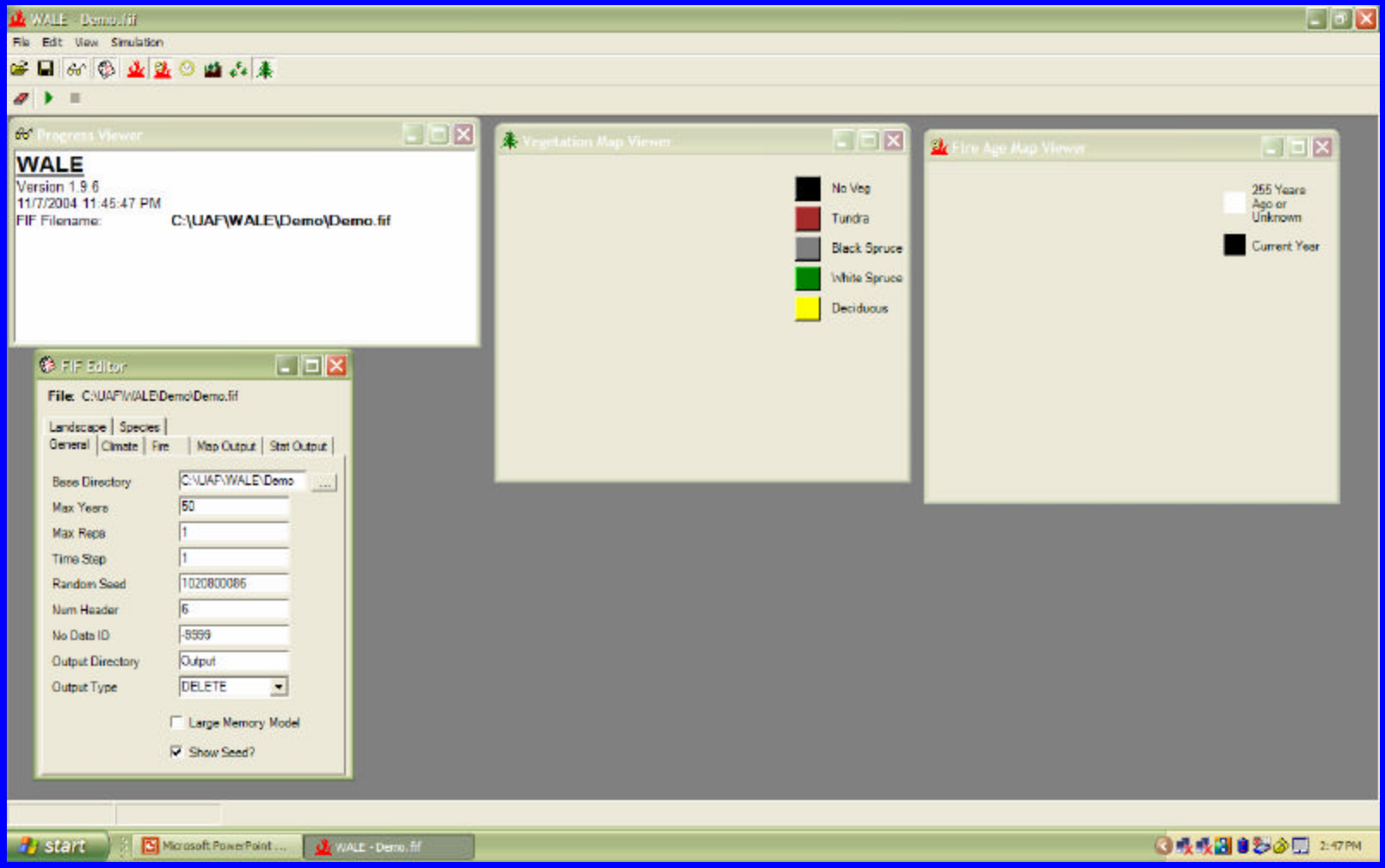

Takahula
Malamute Lake
Rupert
Judy


Takahula
Malamute Lake
Rupert
Judy

Arc/Info ASCII Raster File Format



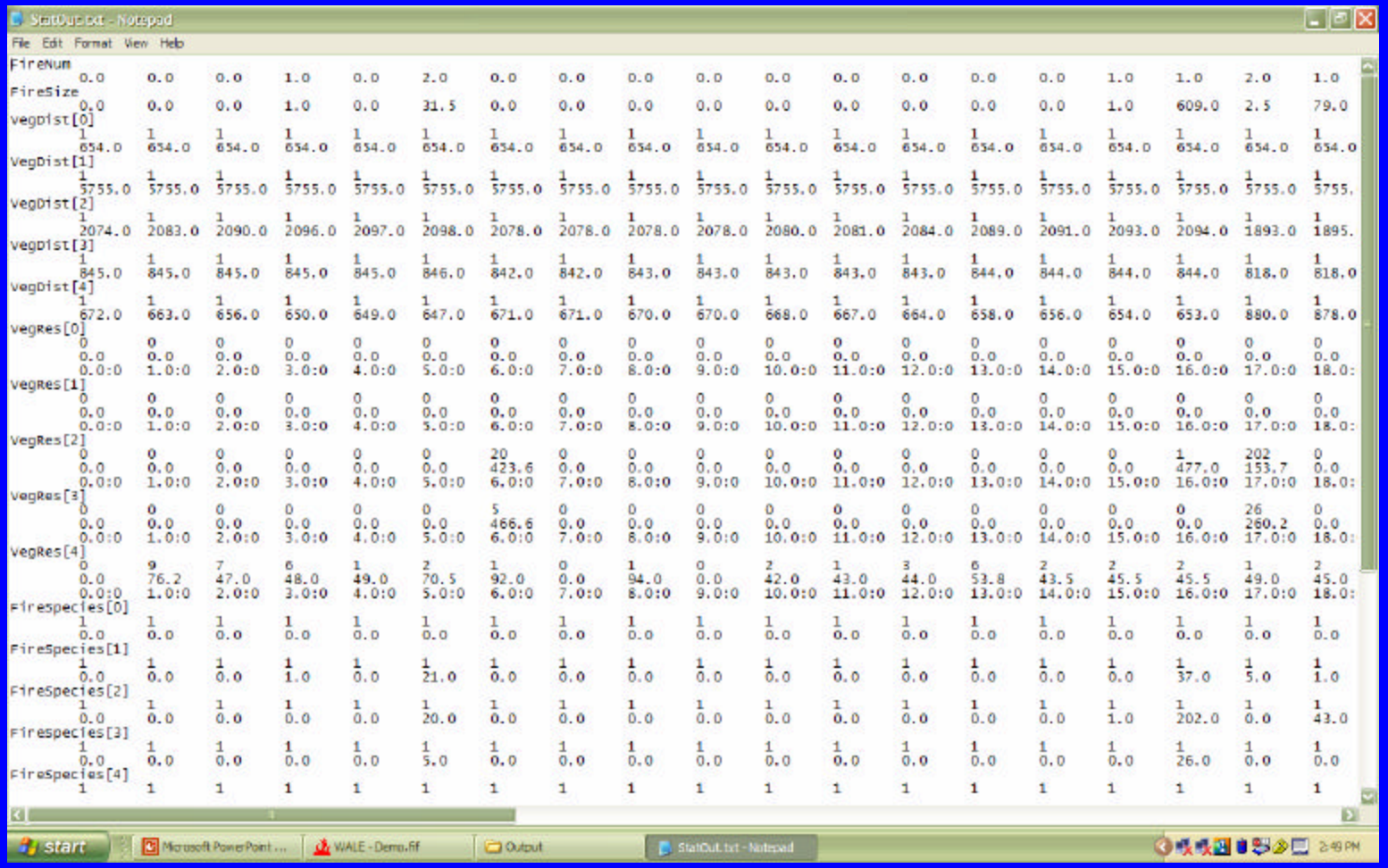
Running WALE 2



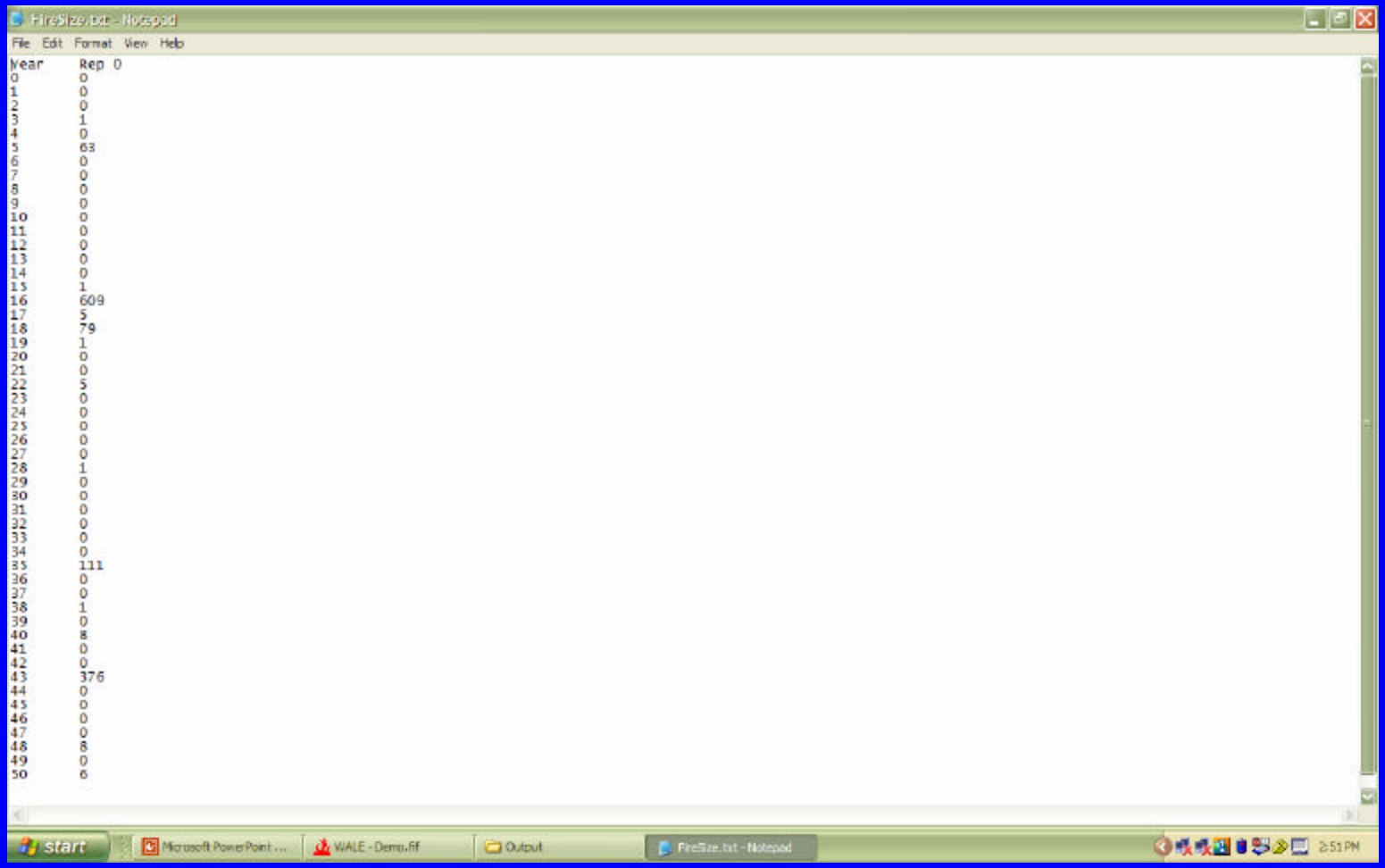
Model Output Types

- Summary Statistics
- Data Files
- Event Files
- Arc/Info Compatible Data Layers

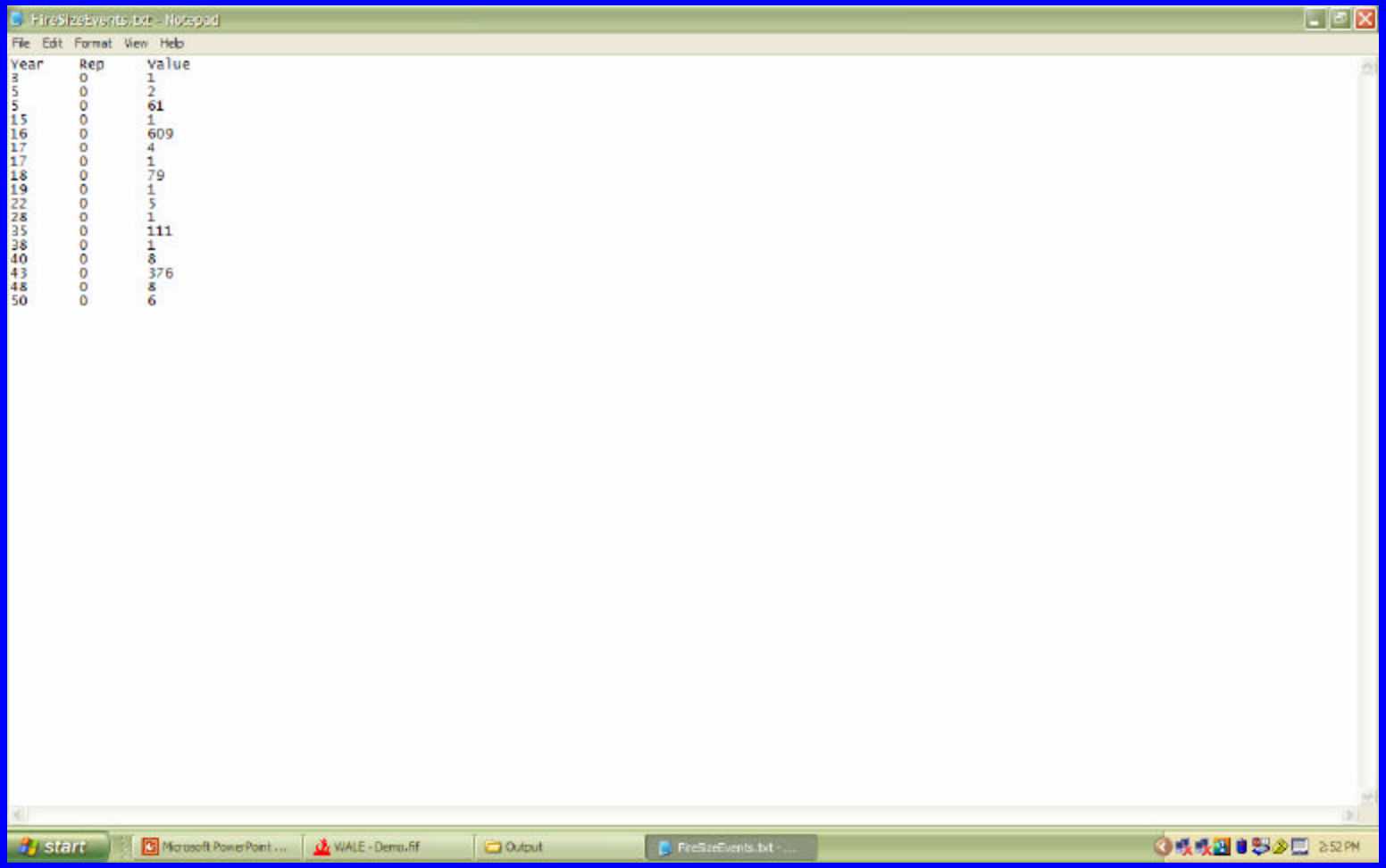
Summary Statistics



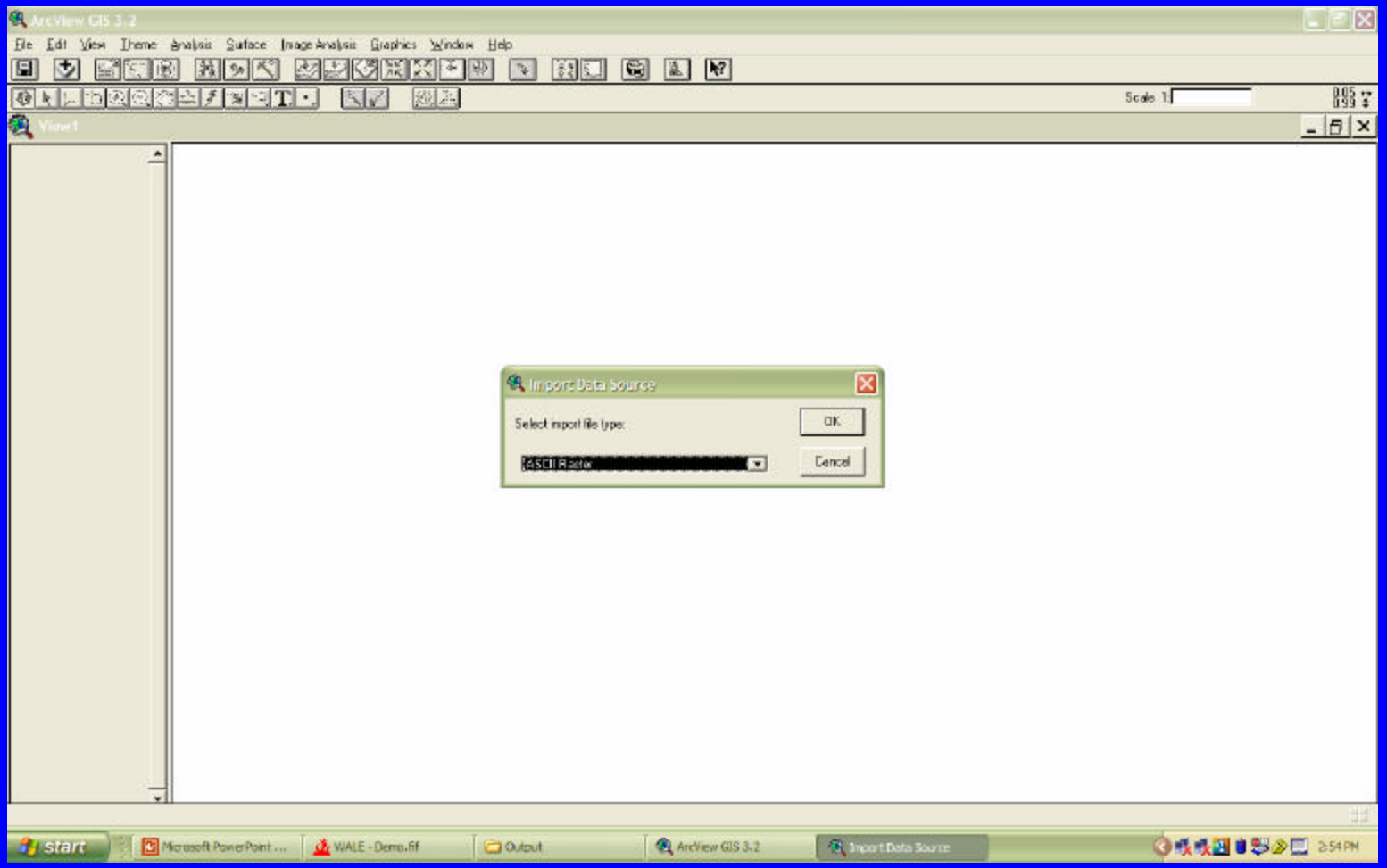
Data Files


FireSize.txt - Notepad
File Edit Format View Help
Year Rep 0
0 0
1 0
2 0
3 1
4 0
5 63
6 0
7 0
8 0
9 0
10 0
11 0
12 0
13 0
14 0
15 1
16 609
17 5
18 79
19 1
20 0
21 0
22 5
23 0
24 0
25 0
26 0
27 0
28 1
29 0
30 0
31 0
32 0
33 0
34 0
35 111
36 0
37 0
38 1
39 0
40 8
41 0
42 0
43 376
44 0
45 0
46 0
47 0
48 8
49 0
50 6
start
Microsoft PowerPoint ...
WALE - Demo.ff
Output
FireSize.txt - Notepad
2:51 PM

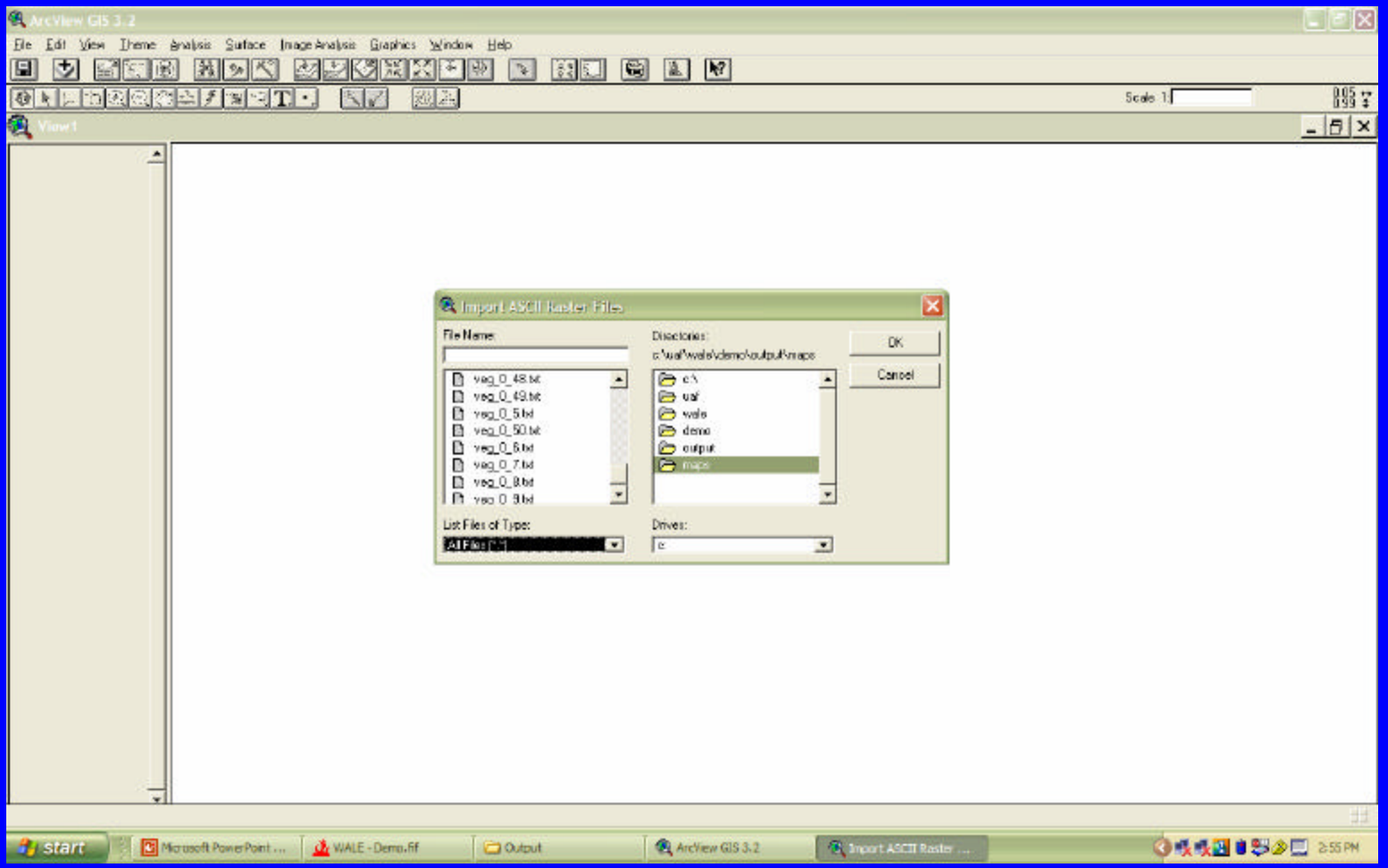
Event Files


FireSizeEvents.txt - Notepad
File Edit Format View Help
Year Rep Value
3 0 1
5 0 2
5 0 61
15 0 1
16 0 609
17 0 4
17 0 1
18 0 79
19 0 1
22 0 5
28 0 1
35 0 111
38 0 1
40 0 8
43 0 376
48 0 8
50 0 6
start
Microsoft PowerPoint ...
WALE - Demo.ff
Output
FireSizeEvents.txt - ...
2:52 PM

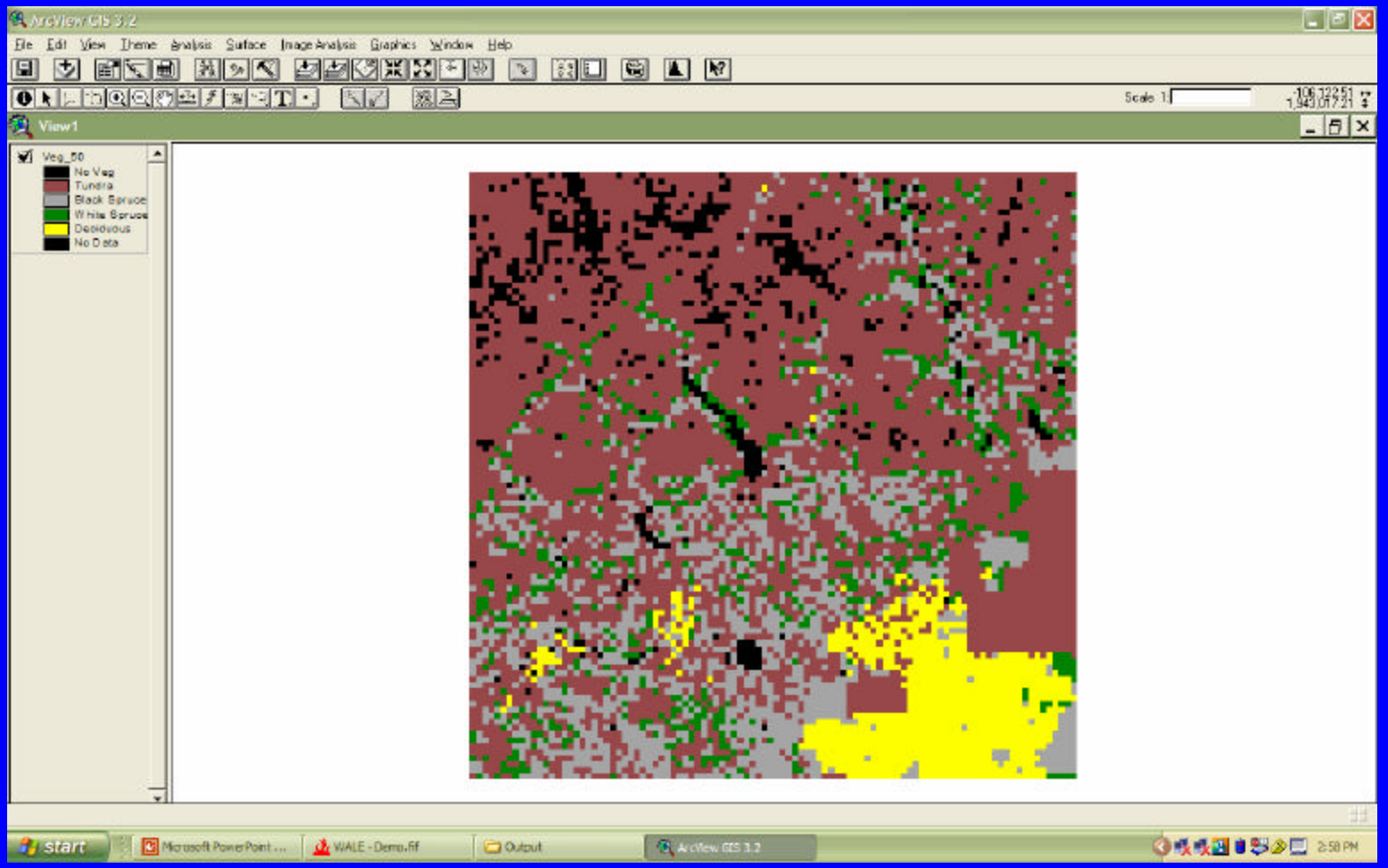
Import Data Source – ASCII Raster Option



Select File(s) of Interest



Simulated Vegetation (t=50)



Development Process and Agenda

Ongoing Development Issues

- Improved Real-time Map Graphics
- Real-time Graphs of Selected Variables
- Improve FIF Editor “User Friendliness”
- Add Suppression Effects
- Add Ignition Types and Location Capabilities
- Develop Agency Requested Scenarios and Data Libraries
- Address Agency/Manager Input/Comments

BETA “Tester” Input

- Identify Problems Running the Model
- Identify Deficiencies in the Model GUI
- Identify Documentation Deficiencies
- Identify Missing Capabilities
- Identify Scenarios and Landscapes to Build

Actively Participate in the Development Stage

Scenario Development Examples

- If you put a doughnut of full protection around a region, does that change the vegetation dynamic on the landscape over time?
- If you institute an aggressive prescribed fire program around a region (e.g., military base) that shortens the fire return interval, what is the effect on vegetation over time?
- Military base again, but you deliberately change areas of mixed and spruce forest to deciduous forest (by selectively cutting out the spruce), what is the duration and effect on fire interval?
- What is the cumulative effect of putting large areas into Modified protection (put out fires until July 11) over time?

From Randi Jandt

Technology Transfer Issues

- Platforms
- Scope of Software Availability
- Training
- Version Upgrades
- Bug Fixes/Maintenance
- Scenario Development

New JFSP Proposal

A Field-Supported, Scale-Integrative, Computer-Management Model of Interior Alaska's Boreal Forest

Mann, Rupp, Duffy – UAF

Murphy – USFWS

Lloyd – Middlebury

Rabus – MacDonald-Dettwiler

Jandt – BLM-AFS

Allen - NPS

Proposal Goals

- Improving Fire Regime Condition Classifications (FRCC) in Alaska
- Helping to lay the foundations for the LANDFIRE project in Alaska
- Further Development and Technology Transfer of Boreal ALFRESCO

Specific Objectives

Determine through fieldwork:

- The relative importance of different successional processes on post-fire landscapes
- The rates of succession in different stand types
- The fire frequency across a range of different landscapes
- The relationship between fire severity, stand age, and stand type

Determine through modeling:

- Reference landscapes for VDDT and FRCC
- Parameterizations for specific VDDT models
- The interactions between recent climatic changes, regional fire regimes, and tree-age legacies
- PNVs for the LANDFIRE effort in Alaska
- Provide improved modeling capabilities and technology transfer for fire managers in Alaska

Support and Input Required

- FRCC National-Level – Wendel Hann
- LANDFIRE National Level – Bob Keane
- AWFCG Research Committee
- USFWS, BLM-AFS, BLM-NRO, NPS
- Kanuti NWR, Yukon Flats NWR
- Others?